USAFETAC/PR-93/002

AN ANALYSIS OF CLOUD-COVER REPORTING in the 1977 SURFACE OBSERVATION DATABASE

by

1st Lt James G. Saccomando, Jr

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859 Buchanan Street
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TERRY LAING, Lt Col, USAF
Chief, Operations Division

JAMES G. SACCOMANDO, Jr, 1st Lt, USAF
Author/Analyst

FOR THE COMMANDER

WALTER S. BURGMANN
Scientific and Technical Information
Program Manager
27 September 1993

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13. Abstract: Describes an analysis of the Air Force climatological surface weather observation database to determine global coverage and frequency of cloud-cover reports during the year 1977. The results of the analysis are depicted by cloud-cover reporting coverage and frequency plotted on global maps.

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PREFACE

This report documents work done on USAFETAC Project 930318, "Station Reporting Locations in '77 Weather Database," requested by the Secretary of the Air Force Space Systems (SAF/SS). To complete a study of cloud effects on AF 1-1 customers, SAF/SS requested ICAO identifiers, WMO identifiers, and coordinates of the surface reporting stations in USAFETAC's 1977 climatological database. The analyst was 1st Lt James G. Saccomando, Jr., USAFETAC/DOS.

USAFETAC/DOS performed this study using USAFETAC's surface audit database, which provided the number of observations for each hour in a single month for each station in 1977. By totaling the number of reports for the entire year and dividing by 12, the analyst was able to determine the average number of cloud cover reports per month, a number useful for determining report frequency and quality. This criterion by itself, however, was inadequate for evaluating stations that only report during daylight hours because, when compared with 24-hour stations, daylight-only stations appear to be poor reporters. The analyst therefore established criteria based not only on the number of reports per month, but on the hours in which the station was active in a 24-hour period, as well.

The results of the analysis were interesting. Area coverage and reporting frequency in Europe and the United States were generally excellent, as was also the case with China, Korea, and Japan. Coverage in parts of Western Asia was mostly good, but reporting frequency was only fair to good. In northwest Asia and northeast Europe, coverage was decent but reporting frequency was poor. As expected, there was hardly any coverage at all in underdeveloped regions of Africa, Siberia, Australia, Northern Canada, Greenland, the Amazon Basin, the Himalayan Mountains, and Antarctica, as well as over the oceans.

INTRODUCTION

SAF/SS tasked USAFETAC to identify and provide the locations of all surface weather reporting stations in the 1977 Climo Weather Data (a subset of the 3DNEPH cloud analysis database). The data was needed to complete a study of the effect of clouds on AF 1-1 precedence customers, and it was needed by 9 April 1993.

In addition to providing locations and identifiers of the stations, USAFETAC expanded the analysis by determining those stations's cloud-cover reporting frequency and area coverage. The on-time response to SAF/SS included not only a diskette containing the list of stations, but five color transparencies (reproduced for this report in black and white) that show global cloud-cover reporting quality and coverage.

DATA USED

To produce the global cloud-cover charts, it was necessary to query the surface audit database, which provided the number of observations for each hour in a single month for each station in 1977. By totaling the reports for the entire year and dividing by 12, we were able to determine the average number of cloud-cover reports per month. This number is definitely useful in determining a station's reporting quality. This criterion alone, however, is inadequate in analyzing stations that only report during daylight hours; even though these stations have fewer cloud cover reports per month, they still report hourly when they are open.

Therefore, DOS determined station cloud-cover report quality according to the criteria shown in the following table. The thresholds were set based on consensus among several experienced meteorologists and are intended only to separate the four quality categories. These quality indicators were included in the data provided SAF/SS.

Excellent
≥ 220 average reports per month
(≥ 140 for daylight-only stations)

Good
≥ 150 average reports per month
(≥ 100 for daylight-only stations)

Fair
> 50 average reports per month , but less than the number required for "excellent" or "good."

Poor
≤ 50 average reports per month

Notes:
1. A "daylight-only station" is one that reports ≤ 5 times a month for 6 consecutive hours.

2. The maximum number of reports from a weather station that reports every 3 hours around-the-clock in a 31-day month is 248.

ANALYZING AND PLOTTING THE DATA

After collecting all the data and downloading it to diskette, DOS created the imagery on its Macintosh computer, using *Microsoft Excel, Atlas Mapmaker,* and *Spyglass Transform.* The file was easily interpreted by *Excel* and formatted for graphic output. Next, a map of the world was created in *Atlas Mapmaker* to be used underneath the transparencies. By using the data visualization capabilities of *Spyglass Transform,* the stations and their reporting qualities were then plotted; they are included as Figures 1-4. Each dot represents a single station's report quality.

Finally, DOS produced an image illustrating *regional* reporting quality (Figure 5). Because surface data influences the RTNEPH model over a distance of about 75 nautical miles (or 1.25 degrees of latitude), we forced each station's

quality to cover a similar area. Therefore, the best quality station in an area represents that entire area on the transparency. For example, if an "excellent" station is near a "fair" station, "excellent" would characterize the approximately 4,400 square nautical miles in that area.

CONCLUSIONS

The plotted data seems consistent with the world's situation in 1977. It is logical that highly populated and technologically developed regions of the planet would support many high-quality weather stations while less heavily populated, under-developed regions could support only a few. This analysis shows that area coverage and reporting frequency in Western Europe, the United States, Japan, China, and Korea was generally Excellent. Regions of western Asia had mostly good coverage, but only fair to good report frequency. Northwestern Asia (western U.S.S.R. in 1977) and northeastern Europe (Eastern Bloc in 1977) had a relatively dense station network, but reporting quality was poor. As expected, underdeveloped regions such as those in Africa, Siberia, Australia, northern Canada, Greenland, the Amazon Basin, the Himalayan Mountains, and Antarctica (as well as over the oceans) had very little coverage. Although the analysis contained no surprises, it was important to ensure that the customer's study was not biased by unexpected surface reports.

SUMMARY

Color imagery clearly offers a better method for analysis. Without data visualization, the regional quality and coverage provided here would have been much-more difficult to infer. In this study, color imagery and data visualization conveyed all the decision-making information necessary in a concise, easily understood format.

Although the figures in this report are reproduced in black and white, color graphics and transparencies are available on request from USAFETAC/DOS, 859 Buchanan St, Scott AFB, IL 62225-5116 (DSN-576-3543).

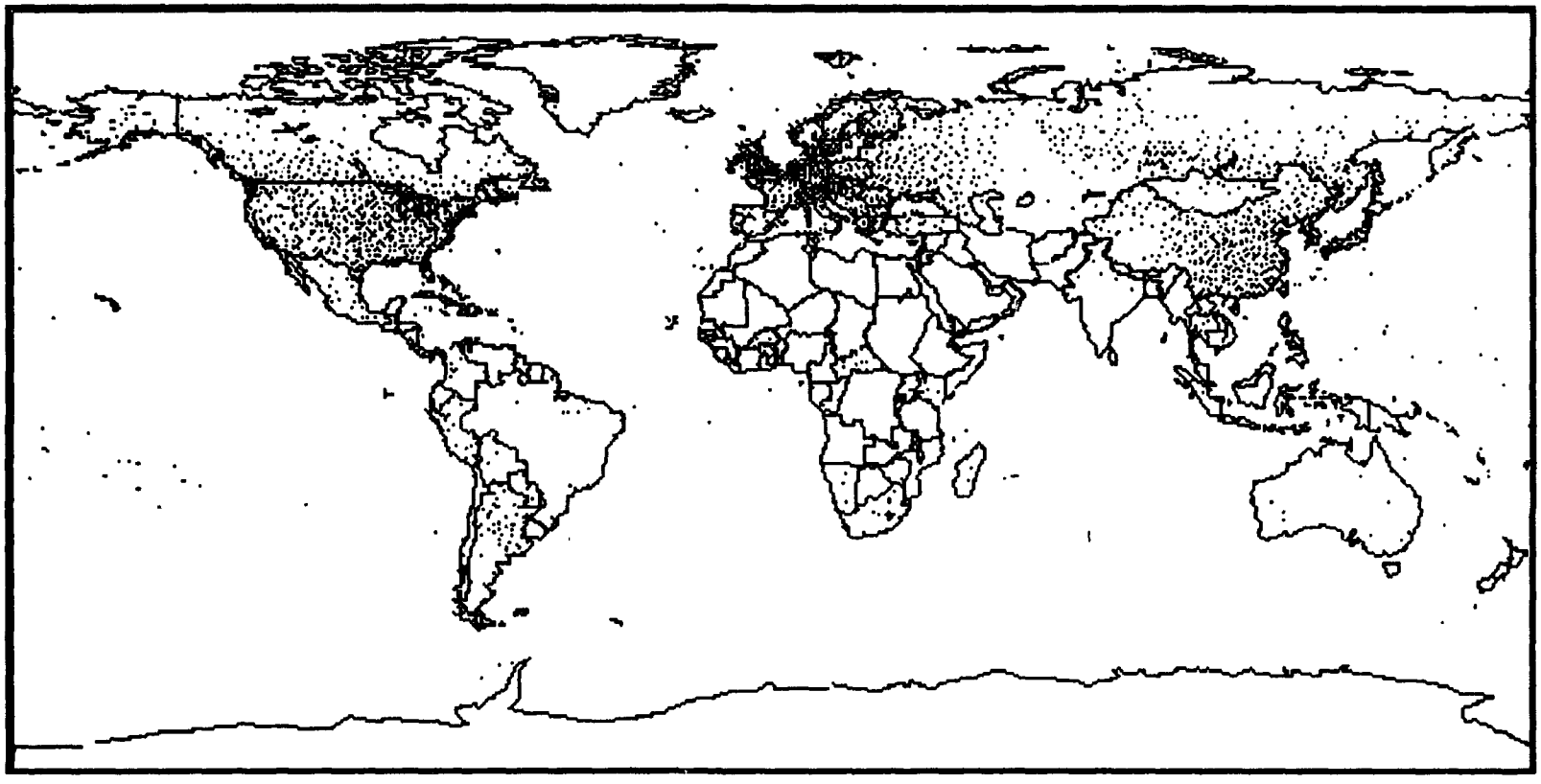

Figure 1. 1977 Surface Stations with "Excellent" Cloud-Cover Reporting.

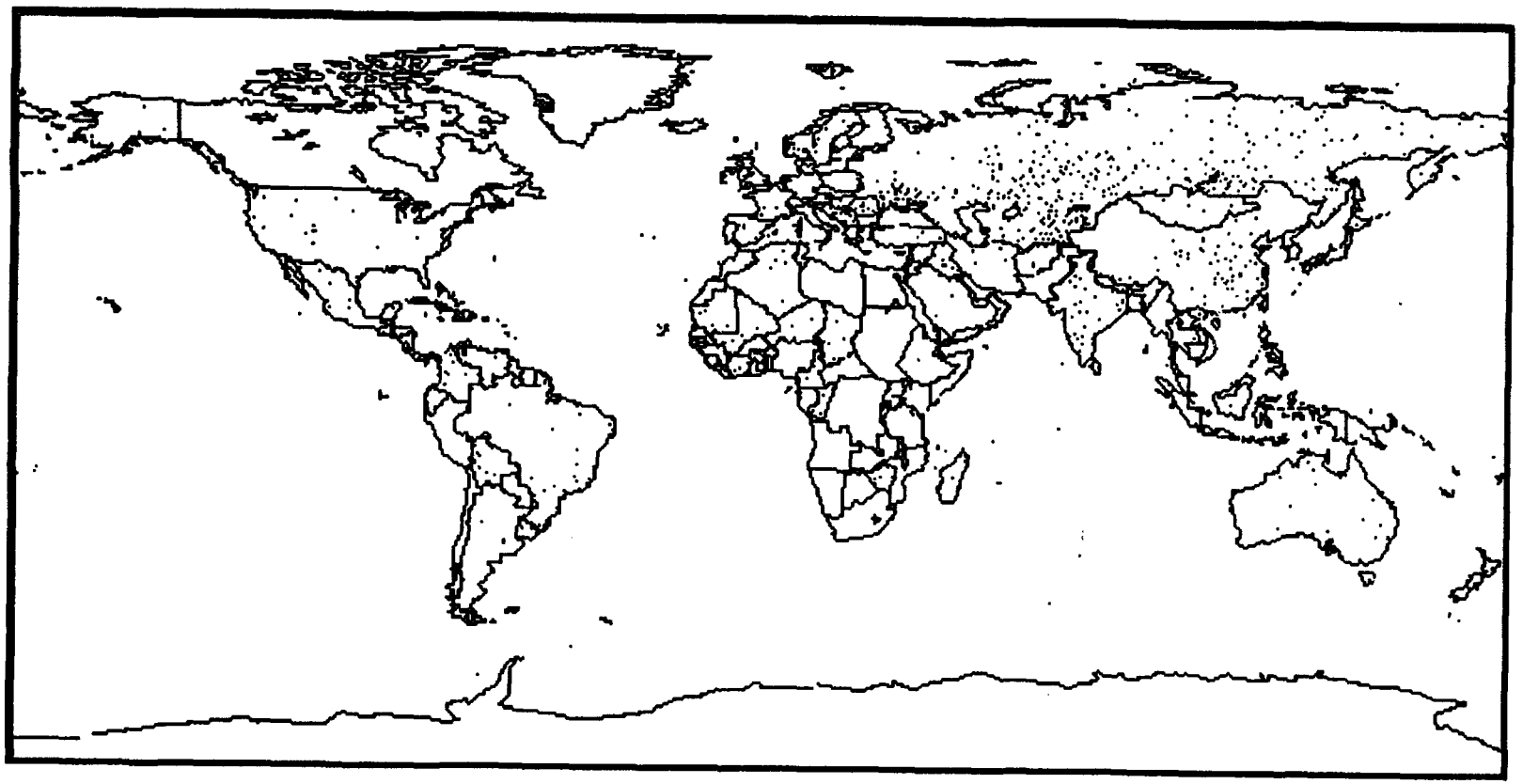

Figure 2. 1977 Surface Stations with "Good" Cloud-Cover Reporting.

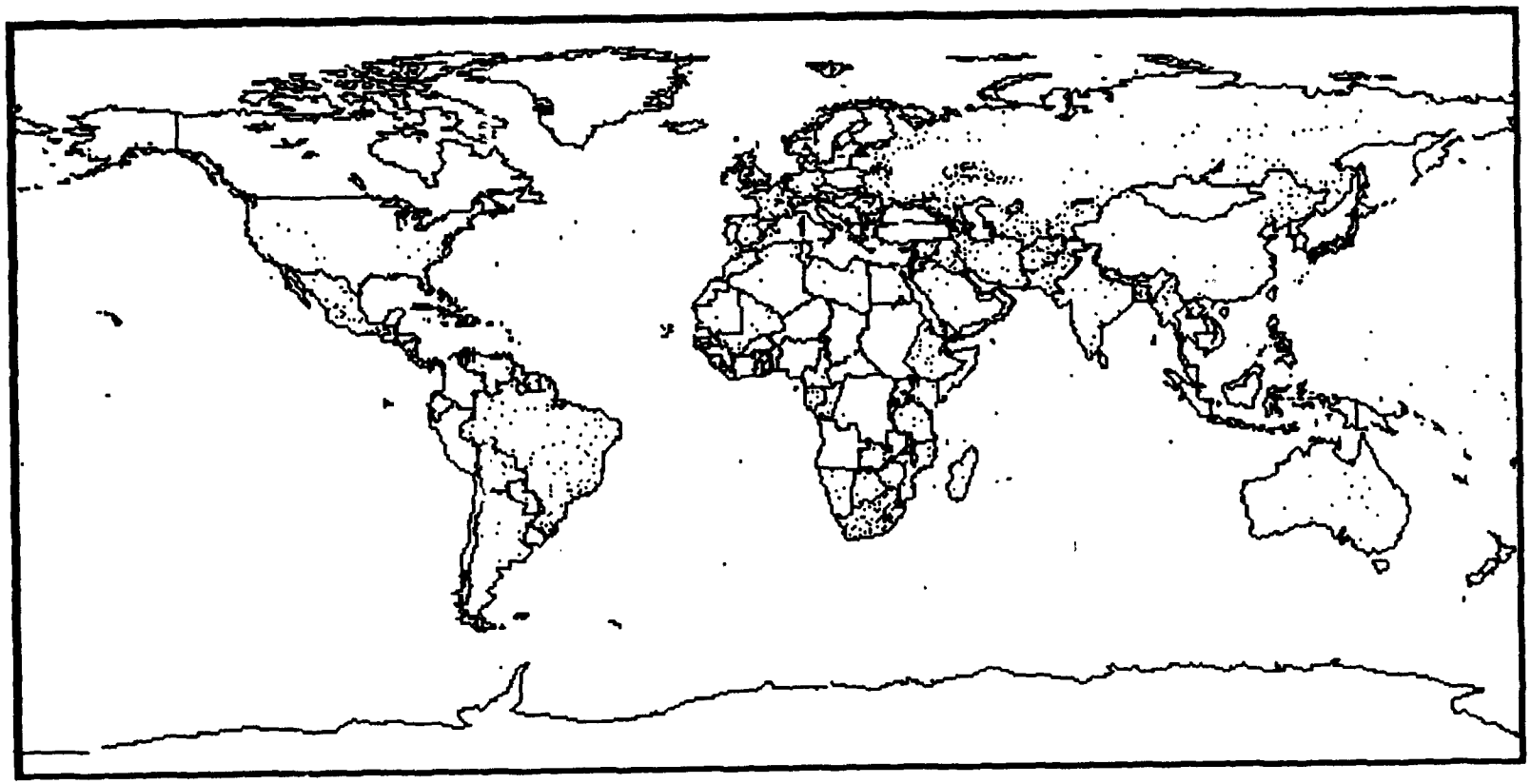

Figure 3. 1977 Surface Stations with "Fair" Cloud-Cover Reporting.

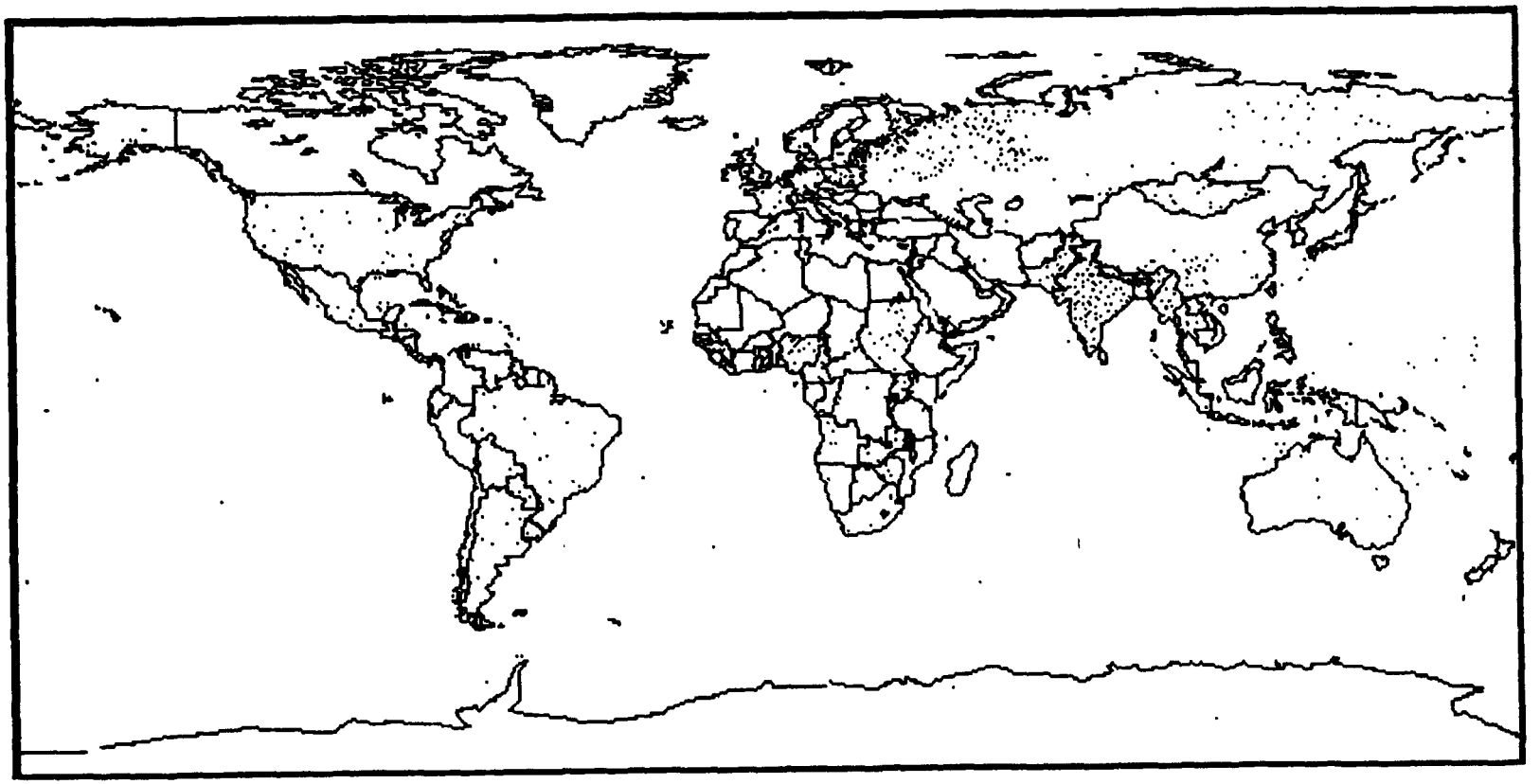

Figure 4. 1977 Surface Stations with "Poor" Cloud-Cover Reporting.

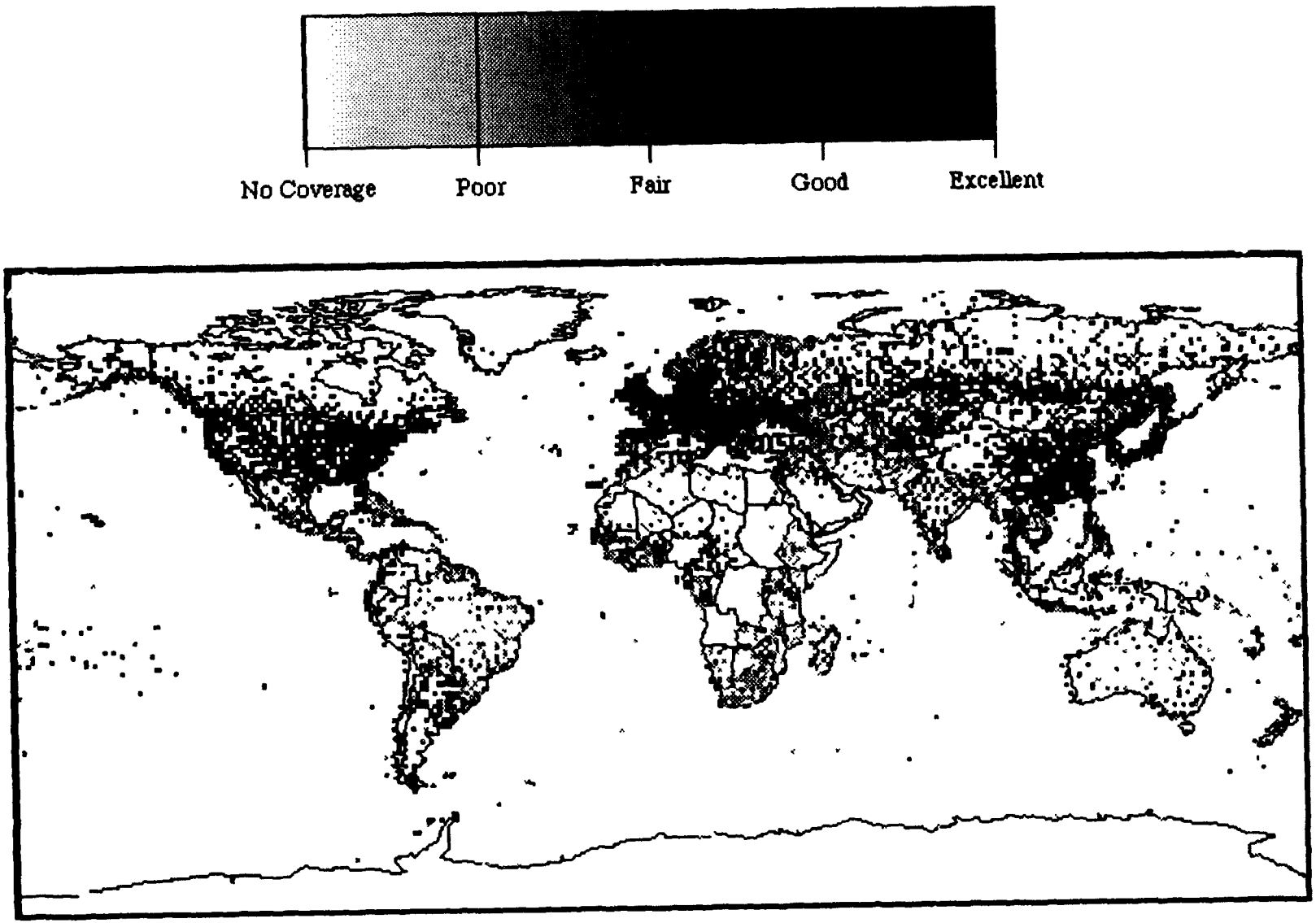

Figure 5. 1977 Surface Stations Area Coverage.

GLOSSARY

3DNEPH	Three-Dimensional Nephanalysis.
ASCII	American Standard Code for Information Interchange.
AWS	Air Weather Service.
DOS	Special Projects Branch of USAFETAC.
ICAO	International Civil Aviation Organization.
RTNEPH	Real-Time Nephanalysis.
SAF/SS	Secretary of the Air Force Space Systems, Pentagon.
USAFETAC	United States Air Force Environmental Technical Applications Center, Scott Air Force Base, Illinois.
WMO	World Meteorological Organization.

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